MORPHOLOGICAL AND BIOLOGICAL NOTES ON SIX SOUTH AFRICAN BLOW-FLIES (DIPTERA, CALLIPHORIDAE) AND THEIR IMMATURE STAGES

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(With 5 figures)

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ABSTRACT

Short biological notes and illustrations are given on *Lucilia sericata* (Meigen), *Chrysomya albiceps* (Wiedemann) and *C. chloropyga* (Wiedemann). Larvae and pupae of *Calliphora croceipalpis* Jaennicke, *Chrysomya regalis* Robineau-Desvoidy, and *C. megacephala* (Fabricius) are described and illustrated with notes on their biology and association with decaying organic matter. A key for the identification of the larvae is provided.

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INTRODUCTION

The blow-flies commonly known as bluebottles and greenbottles are mostly carrion breeders and, apart from the newly introduced oriental latrine fly, *Chrysomya megacephala* (Fabricius), the large bluebottle, *C. regalis* Robineau-Desvoidy, and the cadaver fly, *Calliphora croceipalpis* Jaennicke, are usually the first flies to appear at more or less fresh carcasses and cadavers in the south-western parts of the Cape Province. Both the last-named species have been involved in the past in myiasis in man, *C. regalis* in traumatic myiasis and *C. croceipalpis* in wound and enteric myiasis (Porter 1924; Zumpt 1956).

According to observations made during surveys along the coastal areas from Mossel Bay to Port Nolloth, *C. regalis* infests mainly large animals such as eland and gnu, whereas *C. croceipalpis* was seen to infest bird carcasses and some of the smaller mammals such as rats and dassies; occasionally, however, its larvae were recovered from larger animals such as gnu, but very few adults

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were reared in these cases due to competition by *C. albiceps* (Wiedemann), *C. chloropyga* (Wiedemann), and *C. megacephala*. Both these species infest human cadavers, *C. croceipalpis* apparently mostly during the winter and early spring, and *C. regalis* mostly during the warmer autumn months.

Chrysomya megacephala may also be regarded as a first-wave fly at decaying carcasses; however, it still seems to be restricted to the Cape Town–Yzerfontein and Durban areas as it has not been observed elsewhere. It is commonly found at the Cape Town docks, breeding in ships' holds carrying fish-meal, and this is probably also one of the ways in which it was introduced into this country; the larvae are often found during the late autumn crawling along the railway lines where they breed in dead rats and pigeons.

The green-tailed blow-fly, *Chrysomya chloropyga* (Wiedemann), and the green blow-fly, *Lucilia sericata* (Meigen), are widely distributed in South Africa and are often associated with the above-mentioned species as first- and second-wave flies respectively. Both these flies are facultative parasites and are responsible for sheep myiasis, the first one being subordinate to the second. The final instar larvae of a third species, the banded blow-fly, *Chrysomya albiceps* (Wiedemann), are mostly predaceous on the larvae of the others and they usually develop in carcasses in an advanced state of decomposition.

It is interesting to note that adult blow-flies obtain their carbohydrate requirements from nectar and honeydew, and therefore play an important part in the pollination of flowers such as *Stapelia* (Ryke 1969). Specimens of *Calliphora croceipalpis*, *Chrysomya chloropyga*, and *Sarcophaga* spp. coloured red on the head and thorax by pollen of the plant *Ferraria crispa* (Iridaceae) were often observed in the sandy areas along the west coast. These flies apparently also serve as pollinators of this plant.

In order to study the different instars, the eggs or larvae were placed on rotting flesh in glass jars covered with gauze cloth and containing a layer of about 75 mm of clean, damp sand. Drawings were made with a camera lucida from specimens preserved in 80 per cent alcohol.

Lucilia sericata (Meigen)

Fig. 1A

Adult and larval instars were described by Zumpt (1956, 1965). This brilliant green, shiny blow-fly is apparently attracted by a different set of odours than is the cadaver fly *(Calliphora croceipalpis)* and in most of the cases that were examined it appeared as a second-wave fly. In a few instances, however, particularly in gutted animals, it occurred as a first-wave invader together with one of the flesh flies (*Sarcophaga* sp.). It is one of the most common blow-flies on the islands along the west coast and often breeds in decaying kelp on the beach together with the kelp fly, *Coelopa africana* Malloch.

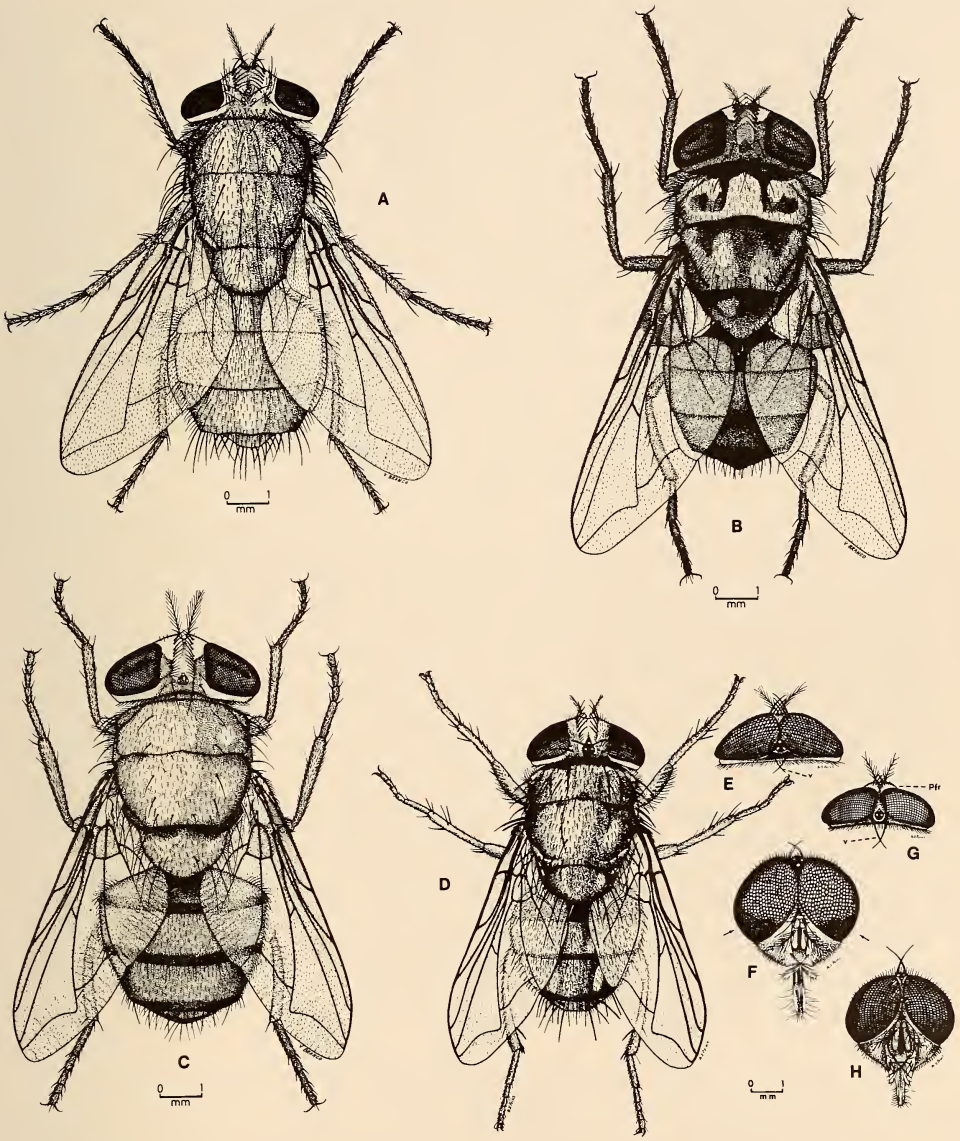

Fig. 1. A. *Lucilia sericata*, female. B. *Chrysomya chloropyga*, female. C. *C. albiceps*, female. D. *C. megacephala*, female. E. *C. megacephala*, head of male from above. F. *C. megacephala*, head of male from the front. G. *C. chloropyga*, head of male from above. H. *C. chloropyga*, head of male from the front.

Eggs collected on human corpses measure, 1,2–1,36 × 0,32–0,36 mm, and closely resemble those of *Chrysomya megacephala* (Fig. 3M), being creamy white, smooth and shiny, and almost without any visible reticulation. The ledges are narrow, as close together as in *C. megacephala*, and extend for nearly seven-eighths of the length of the egg. In most cases the eggs hatched 14 hours after oviposition.

In one test in the laboratory at a room temperature of 25–28 °C, the first instar occupied 14–15 hours and the second 14–17 hours, the larvae reaching a length of 3,4–4 mm 13–16 hours after hatching. The third instar lasted 143–150 hours and the pupal stage about 120 hours, the total larval lifespan in this case was nearly 170–180 hours. In another instance, however, the first and second instars occupied almost 48 hours at 26 °C and the third instar 140–160 hours. The total larval lifespan was 187–204 hours and the pupal stage 192 hours.

Chrysomya albiceps (Wiedemann)

Fig. 1C

Adult and larval instars were described by Zumpt (1956, 1965). The fly varies from 5 to 10 mm in length and is metallic green with a black transverse band across the posterior border of each abdominal segment. It is very widely distributed and as a sheep myiasis producer it is a secondary fly; as far as is known, it has not been recorded on human beings. It has been observed on a wide range of carcasses and cadavers and is usually the last blow-fly to be attracted before the skin-and-hide beetles appear.

Eggs collected on decaying seal carcasses along the west coast vary from 1,4 to 1,5 mm by 0,30 to 0,34 mm, and are very similar to those of *Lucilia sericata* but are duller and with a more pronounced reticulation. All eggs examined hatched 21 hours after oviposition (at temperatures of 25–28 °C).

In the laboratory the first instar lasted 15–20 hours at room temperatures of 25–28 °C, and reached a length of 3 mm about 12 hours after hatching. The second instar occupied 26–30 hours after which they were 6–7 mm long. The third instar varied from 153 hours to 158 hours, the total larval lifespan being 199 hours to 204 hours. The pupal period was 96 hours.

Chrysomya chloropyga (Wiedemann)

Fig. 1B, G–H

Adult and larval instars were described by Zumpt (1956, 1965). A metallic greenish-blue fly with the posterior part of the abdomen greenish yellow, and easily recognized by the ⌟ ⌞ marks on the presutural area of the mesonotum, which are absent in the very similar *C. megacephala*. The eyes of the males without distinct separation of upper and lower facets (Fig. 1H).

The eggs collected on a dead cow measure about 1,6 mm × 0,36 mm and are very similar to those of *C. megacephala*, being also shiny white with an indistinct reticulation.

In two laboratory tests the first instars lasted 20–22 hours at a room temperature of 22–25 °C, after which they measured about 3,5 mm in length. They increased in size reaching 7,9–8,7 mm about 48 hours after hatching; this second instar occupied at least 25–27 hours. The third instar larvae matured after 114–177 hours, the total larval lifespan being 162–230 hours, depending on food availability, temperature and humidity; the mature larvae reached a length of 16–17 mm. The pupal stage lasted from 188 to 204 hours.

In the case of third instar larvae (12–13 mm long), which were removed 85 hours after hatching from their original food source, cessation of feeding was observed and pupation occurred about 38 hours after removal. The total larval lifespan was 85–86 hours. The pupal stage lasted 144–168 hours, the flies emerging being of normal size, but the time necessary to straighten their wings and to assume their normal colour was much longer than in the other tests where the larvae were left undisturbed to mature on their original food supply.

Calliphora croceipalpis Jaennicke

Adult (Fig. 2A–C)

For a detailed description of the adult see Zumpt (1956, 1965). Head and thorax blackish blue to steel blue, almost dull; abdomen more greenish blue and almost shiny and with whitish pollinosity forming large patterns; dark iridescent transverse band present on posterior border of each abdominal segment. Tuft of strong setae present on each side of first visible abdominal segment, just before its posterior border. Four short distinct vittae present on anterior half of presutural area of mesonotum, indistinct over rest of mesonotum. Reddish colour of basal parts of third antennal segments and orange colour of palpi very characteristic. In the males, frontal stripe narrowed by eyes and there are only two vertical bristles, outer verticals (present in female) being absent. Normal length 9–12 mm.

Widely distributed throughout the Subsaharan region, except probably the western parts of Africa. It is common in South Africa and also occurs on some of the islands along the west coast such as Dassen Island.

Larva

First Instar

Similar to mature larva, but spinose girdles on segments 7 and 8 and on posterior side of 11 much less distinct. Cephalopharyngeal skeleton (Fig. 2J) different from that of second and third instars; basal piece widely and deeply emarginate behind; dorsal and ventral cornuae narrow and connected by narrow central piece; anterior dorsal bridge very narrow and widely separating the two dorsal cornuae; parastomal sclerite absent. Mouth-hooks rather weak, and connected to median piece as shown in Figure 2J. Anterior spiracles very indistinct and branches absent. Posterior spiracles (Fig. 2P) with partly developed peritremal ring, orifices ovate and touching ventrally. Just before moulting larvae reach a length of 3,3–4,0 mm.

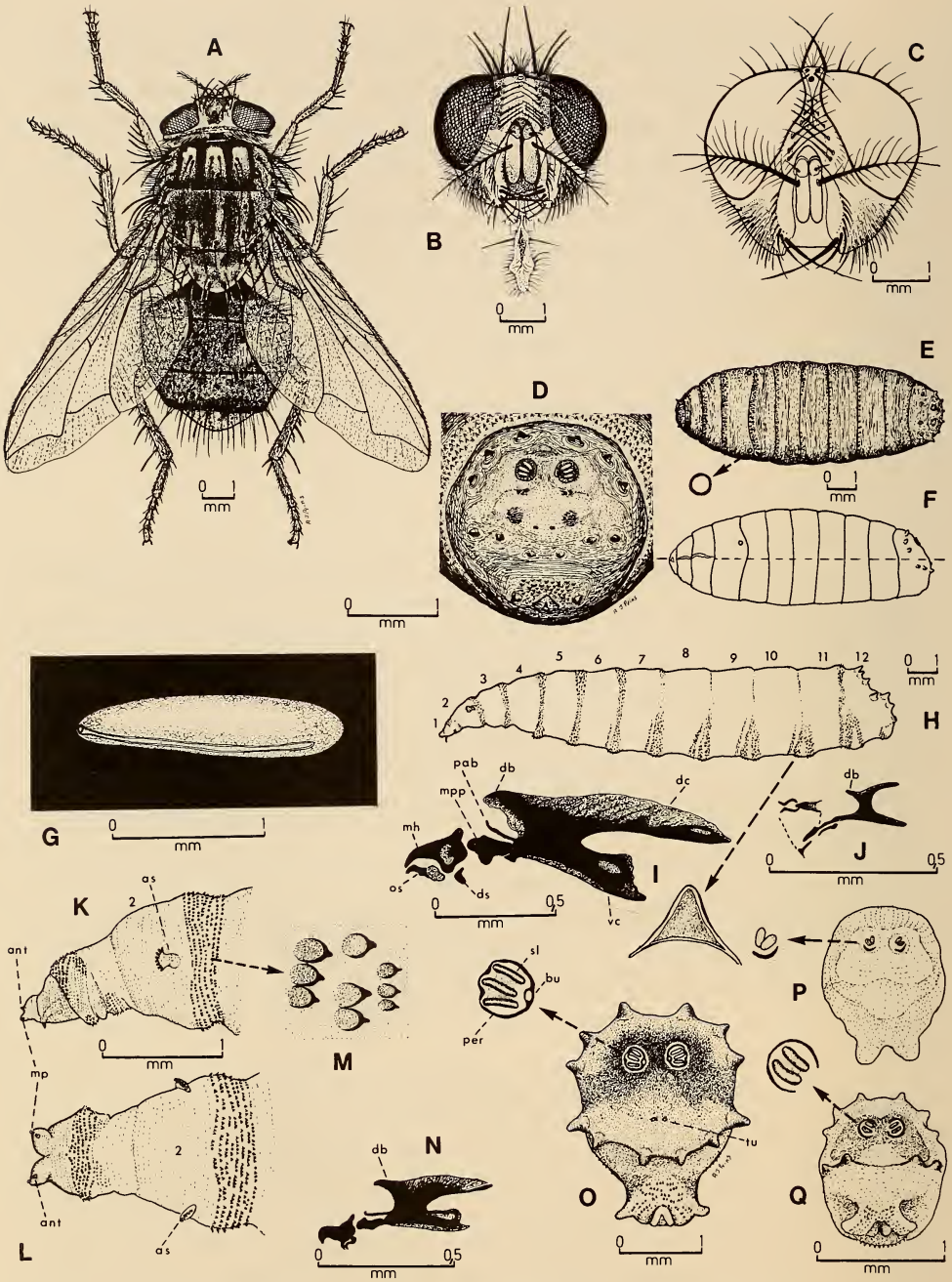

Fig. 2. *Calliphora croceipalpis*. A. Adult female. B. Head, frontal view of female. C. Head, frontal view of male. D. Caudal aspect of puparium. E. Puparium, dorsal view. F. Puparium, left lateral view. G. Egg. H. Third stage larva, left lateral view. I. Cephalopharyngeal skeleton of third instar larva. J. Cephalopharyngeal skeleton of first instar larva. K. First two segments of third instar larva, left lateral view. L. First two segments of third instar larva, dorsal view. M. Spines highly magnified. N. Cephalopharyngeal skeleton of second instar larva. O. Caudal aspect of third instar larva. P. Caudal aspect of first instar larva. Q. Caudal aspect of second instar larva.

Second Instar

Very similar to final instar, including number of branches on anterior spiracles and spinose girdles on body segments. However, cephalopharyngeal skeleton (Fig. 2N) much more heavily sclerotized than in first instar and rather similar to that of third instar larva, except for absence of oral sclerite. Mouth-hooks are more robust and dorsal projections longer and more acute than those of first instar. Parastomal bars or sclerites slender, almost horizontal in specimens seen, and directed upward at extreme apex. Posterior spiracles (Fig. 2Q) much larger and each one with two ovate orifices and an open peritremal ring. Larvae vary from 4,6 to 8 mm in length before moulting occurs.

Third Instar (Fig. 2H–I, K–M, O)

Length 16,5–18 mm when full-grown and creamy white to reddish white, depending on food. Segments 2–8 with complete anterior spinose girdles (sometimes also on segment 9); segments 9–11 with spinose girdles on ventral and lateral sides only; posterior girdles also on ventral side of segments 6–11, that on 11 complete; lateral spines not very distinct in some specimens; segment 12 with anterior ventral girdle and some spines surrounding anus. Spines typically with rounded apical dents, those on more posterior segments with rather broader dents, while larger spines on ventral parts of segments 8–12 are more or less triangular. Head deeply emarginate in front, forming oval lobe on each side, which bears small but rather conspicuous antennae and maxillary palpi. First spinose girdle with dorsal and ventral spines well developed, those placed laterally rather inconspicuous.

Cephalopharyngeal skeleton (Fig. 2I) with ventral cornuae of basal piece shorter than dorsal ones, each with light area with less sclerotization; dorsal ones with lightly sclerotized dorsal area and also with small oval, less sclerotized area near posterior border. When viewed from above the two cornuae fairly parallel or slightly diverging posteriorly. Anterior dorsal bridge complete, somewhat truncate in front and apparently without anterior and posterior projecting lobes. Parastomal bars slender and directed slightly upward particularly at apex. Median piece with complete arched ventral bridge and almost H-shaped when viewed from below. Mouth-hooks fairly wide apart, upper surface in lateral view fairly straight and forming a rounded projection posteriorly. Dental sclerites present; accessory oral sclerite wider than in *C. vicina* (see Zumpt 1965), its basal lobes broad and lightly sclerotized. When seen from below it forms a Y-shaped structure, its basal lobes connected to mouth-hooks, forming posterior arms.

Last abdominal segment (Fig. 2O) with twelve conspicuous fleshy tubercles as well as two smaller inconspicuous tubercles located in posterior cavity some distance above the two median ventral tubercles. Each yellowish posterior spiracle consists of three elongate, brownish oval slits surrounded by closed black peritremal ring with button on inner margin; distance between

spiracles is about same as diameter of a spiracle. Anterior spiracles with eight to nine branches.

Puparium (Fig. 2D–F)

Smooth, dull or slightly shiny, finely and transversely striate; posterior face finely rugulose. Light red when freshly formed, becoming brownish red after day or so. Somewhat constricted just behind anterior spiracular openings, which are small and circular. Respiratory horns absent. Anterior lateral ridges stretch over second and third segment. Twelve small, but conspicuous tubercles surround posterior spiracular plates (Fig. 2D). Posterior spiracles with three distinct elongate slits. Just below each spiracle there is a darker patch and below this patch an almost circular to oval dark spot, slightly smaller than spiracles and absent or inconspicuous in some specimens; between these two patches are two tiny tubercles. Also short black tubercle on each side of anal opening; latter about same size or slightly larger than spiracles. Posterior face convex; spiracles flush with surface and fairly high above longitudinal axis. Normally puparia measure about 9–10 mm.

Biology

This blow-fly was observed around Cape Town almost throughout the year, but was found to be more active during the winter months and early spring. It attacks carcasses of both birds and mammals and, as already stated, is usually the first fly to be attracted to human cadavers. In the laboratory eggs were deposited on the surface of fresh meat, but the flies refused to lay eggs on fairly decayed meat.

Eggs (Fig. 2G) vary from 1,7 × 0,44 mm to 1,8 × 0,44 mm and are white in colour, almost matt, with the surface finely reticulate; the lateral ledges or flanges are narrow and close together, extending for almost the whole length of the egg, the median area between the flanges is narrow. In most cases the eggs hatched within 21–23 hours after oviposition at a room temperature ranging from 18 to 23 °C during August to September. When the temperature was raised to 26 or 28 °C, some of the eggs hatched within 18 hours and in one case three eggs hatched after 15 hours.

The amount of food available and the temperature play an important part in the development of the larvae. However, the available information indicates that the duration of the first stage larva is 23–24 hours, after which the first moult occurs. Just before each moult the spiracles of the next stage become visible through the integument so that it is fairly easy to establish the time of the next moult.

The lifespan of the second instar larva is 37–40 hours at a room temperature of 18–23 °C. The third instar, which may occur about 60 hours after hatching, feeds voraciously for 5–6 days, after which it enters the soil to rest for another 2–5 days before pupation occurs. In most cases the total lifespan of third instar larva was about 8,5 days. The total lifespan of the larvae from egg

to pupa may vary from about 8 days during October to December to about 13 days during July to August, depending on the prevailing humidity and temperature; in tests during August with a room temperature of 18 °C the lifespan of the larvae was 10,75 days (258 hours).

Puparia are formed in the soil without the formation of cocoons and the flies appear after about 14 days from October to December and after 20 days from July to September. The whole cycle from egg to adult is about 25 days during September to November, to about 33 days during July to August.

As only two cases have been reported in the past in which this oviparous species had been identified as causing dermal and intestinal myiasis in man (Porter 1924), it would seem to be only an occasional facultative parasite, probably because it is easily disturbed and because of its habit of alighting and flying around under such circumstances rather than settling down.

Chrysomya regalis Robineau-Desvoidy

Adult (Fig. 3A–C)

This was previously described by Smit (1929) and the genitalia of the male by Zumpt (1956). Colour bright bluish, presutural area of mesonotum somewhat lighter in colour than rest of body, its extreme anterior margin black and with two paramedian longitudinal lines of lighter colour. First visible segment of abdomen blackish, other abdominal segments each with posterior black transverse band; median area of each segment with white pollinosity, showing up as paler areas in incident light. Eyes in life bright red. Parafrontalia and genae yellowish due to presence of fine pubescence and longer fine yellowish hairs, which are blackish round ocellar triangle. Frontal stripe, antennae and palpi somewhat reddish. Vibrissae consisting of only two long black setae.

Females with outer and inner verticals and with no separation between upper and lower facets of eyes. In males only inner verticals present and eyes contiguous in middle; large upper facets of eyes clearly separated from lower smaller facets, as in *C. megacephala*. Easily distinguished from latter species by white anterior thoracic spiracles (blackish brown in *C. megacephala*) and by dark costal margin of wing. Length 9,9–11,5 mm.

Widely distributed over Subsaharan region and also present in Arabia, certain parts of India and the Madagascar region. Although present in most areas surveyed, it is not common.

Larva

Third Instar (Figs 3F, H–K, 4C, 5A)

Length 14–18 mm, similarly coloured to that of *C. croceipalpis*, with complete anterior spinose girdles on segments 2–11, segment 12 with ventral band only and some spines around anus. Anterolateral swelling present on segments 5–10; these adjoin spinose girdles and bear some spines. Head

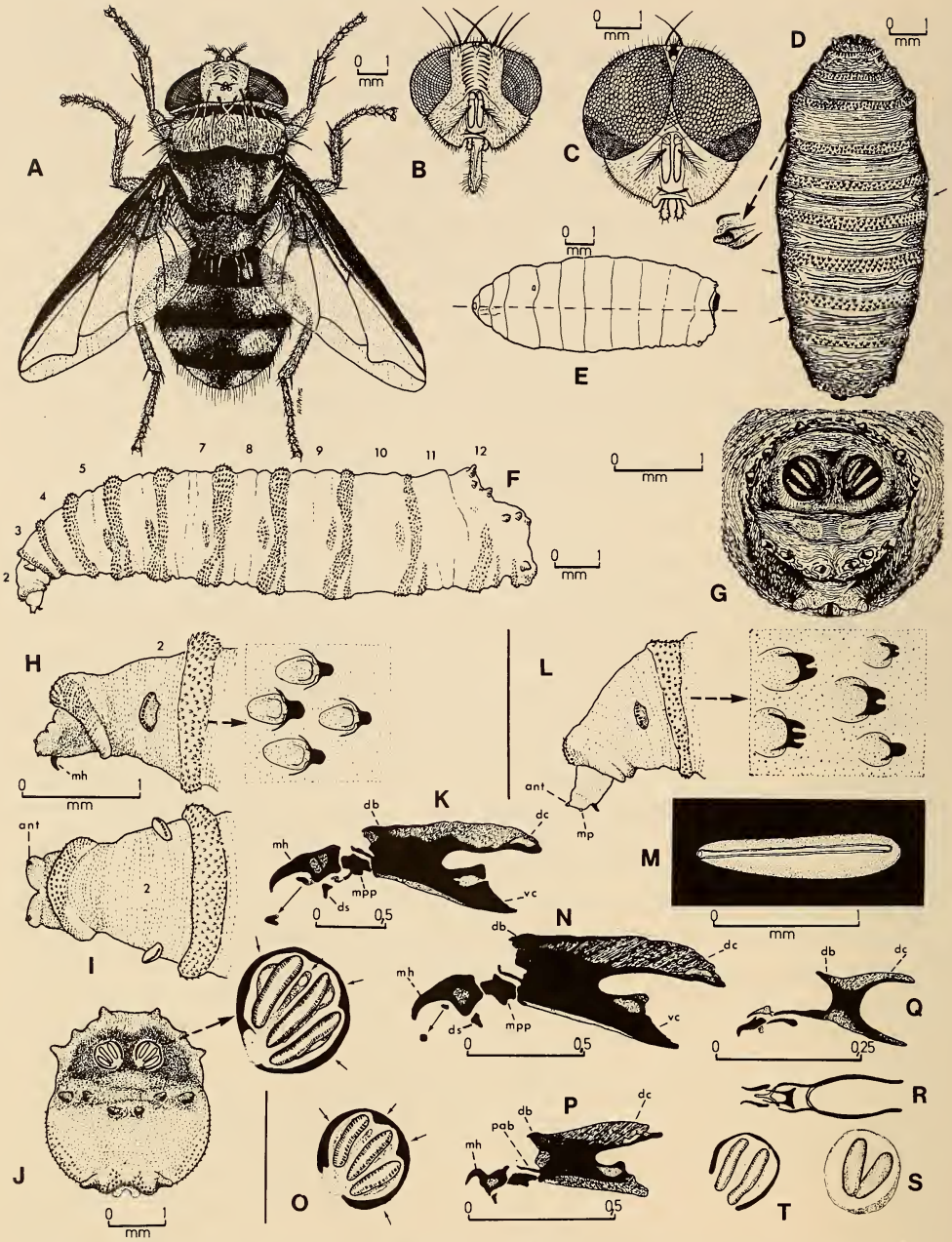

Fig. 3. A–K. *Chrysomya regalis*. A. Female. B. Head of female from front. C. Head of male from front. D. Puparium, dorsal view. E. Puparium, left lateral view. F. Larva, left lateral view. G. Posterior view of puparium. H. First two segments of third instar larva, left lateral view. I. First two segments of third instar larva, dorsal view. J. Posterior view of third instar larva. K. Cephalopharyngeal skeleton of third instar larva. L–T. *Chrysomya megacephala*. L. First two segments of third instar larva, left lateral view. M. Egg. N. Cephalopharyngeal skeleton of third instar larva. O. Right posterior spiracle of third instar larva. P. Cephalopharyngeal skeleton of second instar larva. Q. Cephalopharyngeal skeleton of first instar larva. R. Cephalopharyngeal skeleton of first instar larva, dorsal view. S. Right posterior spiracle of first instar larva. T. Right posterior spiracle of second instar larva.

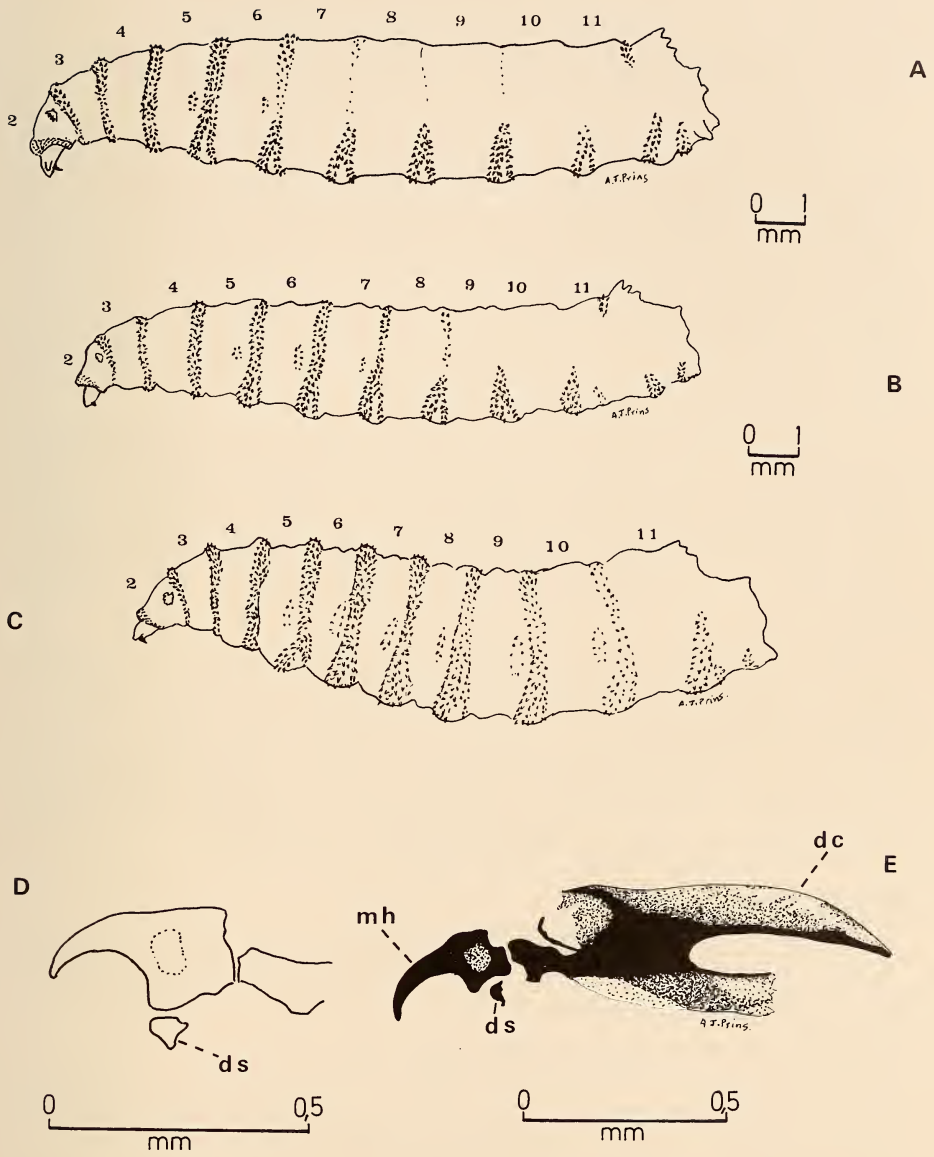

Fig. 4. A. Mature larva of *Chrysomya chloropyga*. B. Mature larva of *C. megacephala*. C. Mature larva of *C. regalis*. D. Mouth-hook of *C. chloropyga*, left lateral view. E. Cephalopharyngeal skeleton of *Lucilia sericata*.

divided into two lobes, each bearing short antenna and maxillary palp. First spinose girdle almost surrounding second segment, spines on its lateral and ventral side small and inconspicuous. All spines on all segments much thicker than in *C. croceipalpis* and almost spoon-shaped. Antennae and maxillary palpi clearly visible.

Posterior spiracles large and yellowish, distance between them slightly less than half the diameter of spiracle, each with open thin black peritremal ring and with three elongate brownish oval slits; each slit with a projection with less sclerotized central area and also with sclerotized elongate sclerite between two inner slits, with circular opening dorsally. These projections, rather characteristic of this species, also present in *C. megacephala*, but spiracles are smaller and projections therefore less noticeable; apparently absent in *C. chloropyga* and *C. albiceps*. Anterior spiracles with eleven to fifteen short branches, the spiracles short and wider than in *C. croceipalpis*.

Cephalopharyngeal skeleton (Fig. 3K) with ventral cornuae almost as long as dorsal ones; anterior dorsal bridge complete, somewhat rounded when seen from above and without any projections; cornuae slightly diverging towards back and forming a narrow V. Parastomal bars slender, fairly straight, somewhat wider in front than behind and somewhat inclined anteriorly, also extended slightly upwards at extreme apex in some specimens (e.g. *C. croceipalpis*).

Median piece with complete, arched ventral bridge, rather similar to that of *C. croceipalpis*. Mouth-hooks without any posterior projections or with short projections, shorter than in *C. croceipalpis*; dorsal surface fairly straight in lateral view, in some specimens slightly raised in middle. Small V-shaped dental sclerite present laterally and only V-shaped basal part of accessory oral sclerite present. Last body segment (Fig. 3J) rather similar to that of *C. croceipalpis*, but two small tubercles present in latter could not be traced.

Puparium (Fig. 3D–E, G)

Smooth, dull, fairly coarsely and transversely striate, striations forming oval rugulose patterns laterally, posterior face also rugulose in certain areas. Colour light reddish when newly formed, but later becoming dark blackish brown. Very small respiratory horns present and puparium somewhat constricted just behind these horns. Anterior lateral ridges not very conspicuous, extending over second and third segments and located on or just below longitudinal axis. Anterior spiracles somewhat fan-shaped and yellow. Spinose bands present on almost all segments, those on segment 9 inconspicuous and narrower than those on others. Posterior face (Fig. 3G) rather truncate, spiracles large, somewhat protruding and enclosed in black peritremal ring, slits yellowish brown to almost orange. Twelve tubercles surrounding spiracular plates not very distinct. Oval shallow depression present below each spiracle, latter situated above longitudinal axis. Anal opening similar to that of *C. croceipalpis* and with short projections on each side. Puparium measures 8,9–10 mm long.

Biology

According to Ullyett (1950) *Chrysomya chloropyga*, *C. albiceps*, and *Lucilia* have a distinct advantage over *C. regalis* in interspecific competition for food, as the total growth period of the latter species is longer than any of the above-mentioned species. He also states that *C. regalis* is the least well adapted to withstand the adverse conditions engendered by larval overcrowding. Because of its larger size and considerably longer period of growth, combined with the essentially limited nature of available carrion in the field, it is not well favoured for the production of large populations of adults, as is possible in the case of *Lucilia*. This statement does not seem to be altogether true, as in three carcasses of large mammals examined during the present investigation (particularly that of an eland) very large populations of this fly were produced, with a fairly low rate of mortality, and in all the samples taken (some of which comprised up to 8 000 larvae) dwarfing was not observed; although a fairly large number of eggs was produced by *C. albiceps*, none survived. Apart from this, *C. regalis* is a first-wave blow-fly and, by the time the *C. albiceps* adults were attracted, large numbers of *C. regalis* larvae had already hatched, and due to their vigorousness they managed to compete for survival both intra- and interspecifically. *C. regalis* may, however, be subordinate to *C. chloropyga*, also a first-wave blow-fly and, as in the case of the latter, appears to be attracted to fairly fresh meat, but has not been found during these surveys in association with other blow-flies except *C. albiceps*.

The larval lifespan in all cases examined was about 11 days during late summer (compare with *C. chloropyga*, in which it was 6–9 days (summer) and *C. croceipalpis*, with a larval span of 8–9 days (summer)). The pupal stage lasts about 9 days during summer and about 14 days during spring (*C. chloropyga* 5–8 days and *C. croceipalpis* about 14 days (early summer) to 20 days (late winter)).

This blow-fly seems to be restricted to the autumn months as most of the infestations occurred during March and April, the fly being almost absent during the summer months, which is in agreement with the findings of Smit (1931). The puparia are usually formed under the carcass or in the soil without the formation of cocoons.

Chrysomya megacephala (Fabricius)

Adult (Fig. 1D–F)

Various stages previously described by Zumpt (1965) and Prins (1979). Colour metallic greenish; easily separated from our other South African species (*albiceps*, *chloropyga* and *regalis*) by the blackish-brown anterior thoracic spiracles (white in the other species). In females there is no separation between facets of the upper and lower halves of eyes but in males lower, smaller facets are clearly separated from larger ones in upper half of eyes (Fig. 1F). Otherwise very similar to *C. regalis*, but lacking dark costal area of the wings. Length 8,9–10 mm.

Widely distributed in Oriental, Madagascan, Australasian and Palaearctic regions; recently also found in Brazil, Senegal, and the west coast and Durban areas of South Africa.

Larva

First Instar (Fig. 3Q–S)

Very similar to last-stage larva except for size and shape of posterior spiracles (Fig. 3S), which have two elongate slits touching each other ventrally. Peritreme somewhat stronger developed on ventrolateral side and rather similar to that of *Calliphora croceipalpis*. Cephalopharyngeal skeleton (Fig. 3Q–R) also similar to that of first instar of *C. croceipalpis*; however, mouth-hooks broader in lateral view and with definite short dorsal projections. Central piece connecting the two cornuae broader than in *C. croceipalpis*; the sclerite when seen from above not so pointed in front as in that species.

Second Instar (Fig. 3P, T)

Very similar to mature larva, except for absence of anterior lateral swellings, which are present on segments 5–8 in mature larvae. Anterior spiracles with eight to nine small branches. Posterior spiracles (Fig. 3T) similar to those of *C. croceipalpis* but smaller, slits oval and elongate. Cephalopharyngeal skeleton (Fig. 3P) with basal piece similar to that of third instar larva; anterior dorsal bridge complete and with short posterior projections; mouth-hooks in lateral view narrower than those of *C. croceipalpis* and directed slightly upwards; posteriorly a small, almost acute projection also present. Ventral bridge of middle piece more arcuate and therefore more clearly visible laterally than in *C. croceipalpis*. Small dental sclerite present on each side.

Third Instar (Figs 3L, O, 4B, 5B, E)

Very similar to that of *C. regalis*, measuring 13,5–15 mm in length. Anterior spinose girdles present on all segments, those on segments 2–8 complete, that on segment 9 interrupted laterally. Segment 10 without dorsal spines; segment 11 with posterior girdle; segment 12 with ventral band and some spines around anus. Segments 5–8 with anterior lateral spinose swellings similar to those of *C. regalis*. First spinose girdle on second segment with dorsal spines strongly developed, lateral ones small and inconspicuous; ventral ones somewhat better developed. Head divided as in *C. regalis*. Antennae fairly conspicuous. Posterior face of abdomen hollowed out as in latter species, the fleshy tubercles surrounding spiracular plates and those on each side of anus also as in that species. Spines on body integument mostly bi- or tridentate, including some smaller ones, others spoon-shaped as in *C. regalis*.

Anterior spiracles with 8–10 short branches (Zumpt (1965) gives the number as 11–13); posterior yellowish brown spiracles (Fig. 3O) similar to those of *C. regalis* but smaller, projections not so conspicuous as in that species and distance between spiracles about half or slightly more than half diameter of spiracle.

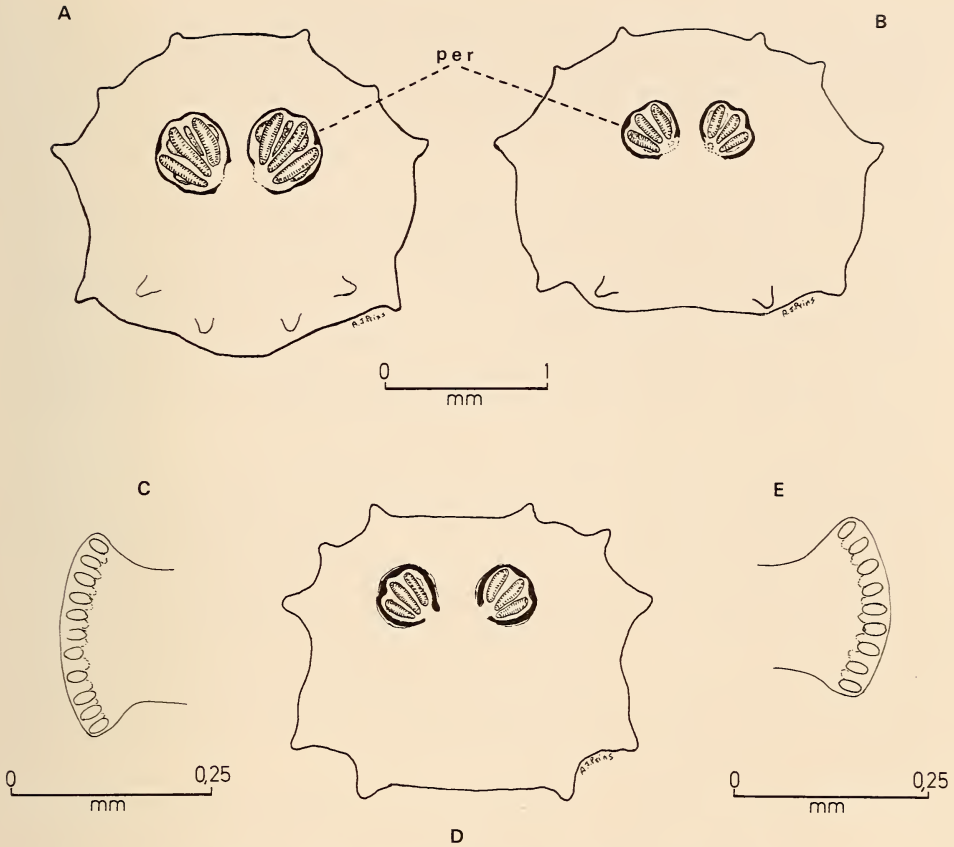

Fig. 5. A. Posterior view of mature larva of *Chrysomya regalis*. B. Posterior view of mature larva of *C. megacephala*. C. Left anterior spiracle of mature larva of *C. chloropyga*. D. Posterior view of mature larva of *C. chloropyga*. E. Right anterior spiracle of mature larva of *C. megacephala*.

Cephalopharyngeal skeleton (Fig. 3N) similar to that of *C. regalis*, but basal part of oral sclerite smaller and not V-shaped in most specimens seen; dorsal outline of mouth-hooks in lateral view more convex, the concave posterior area smaller. Anterior dorsal bridge complete and with short posterior projection on each side, almost rounded in front in some specimens.

Puparium

Colour reddish brown to mahogany brown, with anterior spiracle fan-shaped and yellow. Rather similar to that of *C. regalis*. but oval, rugulose areas absent on sides. Ridge around the spiracular plates formed by surrounding tubercles not so conspicuous as in latter species and spiracles much smaller, their diameter being about one-fifth diameter of posterior area surrounded by tubercles (in *C. regalis* diameter of spiracles is about one-fourth diameter of

posterior area). As in the latter, two oval depressions are present below spiracles, which may be confluent in some specimens. Respiratory horns very small as in *C. regalis* and in most specimens examined anterior part of puparium is somewhat broader and shorter when seen from above than in latter species.

Biology

Adult flies were observed mostly during the late summer and early autumn and were attracted to both mammal and bird carcasses as well as to human excrement. The eggs (Fig. 3M) are very similar to those of *C. croceipalpis* but are smaller, measuring about 1,38 × 0,33 mm, and fairly shiny, with the reticulation very superficial and visible only under certain light conditions. As in *C. croceipalpis*, the ledges are narrow, close together and extend for almost the whole length of the egg. The incubation period is short, only about 14 hours at 26 °C.

In breeding tests in the laboratory the duration of the first larval instar was about 23 hours, during which period they reached a length of 3–4 mm; the second instars lasted about 21 hours at 26 °C. When the second moult occurs they are usually about 6 mm long and by this time the spiracles of the last instar are clearly visible through the integument. After reaching the third instar (about 44 hours after hatching), they feed for 60–72 hours and then burrow into the soil to pupate. The total larval lifespan at 26 °C was 140–148 hours in the laboratory. According to Wijesundara (1957) the life cycle from egg to adult takes 204 hours in Sri Lanka; in Cape Town it varied from 276 to 306 hours, the pupal stage lasting 136–144 hours.

KEY FOR IDENTIFICATION OF LARVAE

The following key will assist in the identification of the full-grown larvae of the six common blow-flies described above.

1. Larvae with fleshy processes on most segments ..... *Chrysomya albiceps*
— Larvae without fleshy processes on most segments.
2. Posterior spiracles with closed peritremal ring (Fig. 2O) 5
— Posterior spiracles with open peritremal ring.
3. Posterior spiracles large in relation to posterior face (Fig. 5A), the projections between slits, particularly the one between the inner two slits, distinct. Dorsal spines of girdles on at least anterior half of body broadly rounded, not cleft (Fig. 3H). Segments 2–11 with complete spinose girdles (Fig. 4C). Mouth-hooks with small accessory oral sclerite present ..... *Chrysomya regalis*
— Posterior spiracles smaller in relation to posterior face (Fig. 5B, D), the projections between slits, particularly the one between the inner two slits, indistinct. Most of dorsal spines of girdles on at least anterior half of body bi- or tridentate (Fig. 3L). Segments 2–9 with complete spinose girdles 4
4. Segments 2–7 and sometimes 8 with obviously complete spinose girdles (Fig. 4A). Mouth-hooks devoid of accessory oral sclerite (Fig. 4D), and anterior spiracles with 10–12 branches (Fig. 5C) ..... *Chrysomya chloropyga*
— Segments 2–8 and sometimes 9 with obviously complete spinose girdles (Fig. 4B). Mouth-hooks with small accessory oral sclerite (Fig. 3N), and anterior spiracles with 8–10 short branches (Fig. 5E) ..... *Chrysomya megacephala*
5. Mouth-hooks with accessory oral sclerite (Fig. 2I) ..... *Calliphora croceipalpis*
— Mouth-hooks without accessory oral sclerite (Fig. 4E) ..... *Lucilia sericata*

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ABBREVIATIONS

ant	antenna	mpp	middle piece or hypostomal sclerite
as	anterior spiracle	os	accessory oral sclerite
bu	button	pab	parastomal bar
db	anterior dorsal bridge	per	peritremal ring
dc	dorsal cornua	sl	slit
ds	dental sclerite	tu	tubercle
mh	mouth-hook	vc	ventral cornua
mp	maxillary palp		